

***Parapharyngodon japonicus* sp. n. (Nematoda: Pharyngodonidae) from the Japanese Clawed Salamander, *Onychodactylus japonicus* (Caudata: Hynobiidae), from Japan**

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ABSTRACT: *Parapharyngodon japonicus* sp. n. from the large intestine of the Japanese clawed salamander, *Onychodactylus japonicus* (Houttuyn), is described and illustrated. *Parapharyngodon japonicus* is most similar to *P. tyche* in that the anterior cloacal lip is smooth, the ovary is postbulbar, and the eggs are thin-walled and oval in outline. These 2 species differ in that the spicule of *P. japonicus* is half the length of that in *P. tyche* and the lateral alae of *P. japonicus* end abruptly about 80 μ m anterior to the cloaca, whereas in *P. tyche* the lateral alae continue to the end of the body. Two species are transferred from *Parapharyngodon* to *Thelandros* and represent new combinations: *Thelandros awakoyai* (Babero and Okpala) comb. n. and *T. senisfaciecaudus* (Freitas) comb. n.

KEY WORDS: *Parapharyngodon japonicus* sp. n., Pharyngodonidae, *Onychodactylus japonicus*, Hynobiidae, Amphibia, salamander, Japan.

The validity of *Parapharyngodon* Chatterji, 1933, has been in question almost since its proposal by Chatterji (1933). Baylis (1936) considered it to be a synonym of *Thelandros* Wedl, 1862; Karve (1938), García-Calvente (1948), and Skrjabin et al. (1951) maintained this synonymy. Freitas (1957) reinstated the genus; Chabaud (1965) returned it to synonymy with *Thelandros*. Sharpilo (1976), on the basis of the presence of lateral alae, reinstated *Parapharyngodon*, but Petter and Quentin (1976) did not accept lateral alae as a differential character and again synonymized *Parapharyngodon* with *Thelandros*. Adamson (1981) reestablished *Parapharyngodon* based on the dietary habits of the host, genital cone morphology (well developed in males of *Thelandros*, reduced or absent in *Parapharyngodon*), egg morphology (operculum, if present, polar in position, larvated at deposition in *Thelandros*; subpolar operculum, deposited in early stage of cleavage in *Parapharyngodon*), and morphology of the tail of females. Castaño-Fernandez et al. (1987) supported retention of *Parapharyngodon* but restricted separation of the 2 genera to morphological characters, not dietary habits. Males of *Parapharyngodon* lack a genital cone, papillae surround the cloaca, the accessory piece is absent, and the tail is subterminal and curved dor-

sally, whereas males of *Thelandros* have a narrow, elongated genital cone (sometimes with an accessory piece), papillae are outside the genital cone, and the tail is terminal. Females of *Parapharyngodon* have a conical tail ending in a short spike and the eggs have a subterminal operculum and are in the early stages of cleavage when released. Females of *Thelandros* have various caudal morphologies; in some species the tail is conical, tapering evenly from the anus, whereas in others it is rounded and supports a short filiform appendage. The eggs of *Thelandros* have a terminal operculum and are larvated at deposition.

The Japanese clawed salamander, *Onychodactylus japonicus* (Houttuyn, 1782), is restricted to mountainous areas of Honshu and Shikoku Islands, Japan, where it inhabits coniferous and broad-leaved deciduous forests 20–2,000 m above sea level (Kuzmin, 1995). The ancestors of *O. japonicus* supposedly reached Japan from continental Asia by way of the Korean peninsula (Kuzmin, 1995). Previously reported helminths of *Onychodactylus japonicus* include: the monogenetic trematode, *Pseudopolystoma dendriticum* (Ozaki, 1948); the digenetic trematodes, *Cephalouterina leoi* Uchida, Uchida, and Kamei, 1986, and *Mesocoelium brevicum* Ochi, 1930; the cestode, *Cylindrotaenia* sp. (= *Baerietta* sp., larvae only); and the nematodes, *Amphibiocapillaria tritonispunctati* (Diesing, 1851)

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(=*Capillaria filiformis* (Linstow, 1885)), *Pseudoxyscaris japonicus* Uchida and Itagaki, 1979, *Pharyngodon* sp., and *Rhabditis* sp. (Wilkie, 1930; Pearse, 1932; Ozaki, 1948; Uchida and Itagaki, 1979; Uchida et al., 1986). To our knowledge there are no reports of *Parapharyngodon* from Japanese salamanders, although Hasegawa (1988) reported an unidentified species of *Parapharyngodon* from the scincid lizard, *Ateuchosaurus pellopleurus* Hallowell, 1860, from Okinawa, Japan. The purpose of this paper is to describe a new species of nematode, *Parapharyngodon japonicus* from a salamander *Onychodactylus japonicus* from Japan, and to provide a current list of species assigned to the genus *Parapharyngodon*.

Materials and Methods

Sixty-eight *Onychodactylus japonicus*, mean snout-vent length = 62.4 ± 4.3 mm (range 43–72 mm), were collected by hand and fixed in neutral buffered 10% formalin, preserved in 70% alcohol, examined for intestinal helminths, then deposited in the Natural History Museum of Los Angeles County (LACM). Sixty-five were from Hineomata Village (37°01'N, 139°23'E), 1,100–1,200 m elevation, Fukushima Prefecture, Honshu Island, Japan (LACM 143245–143260, collected 13 June 1995; LACM 143715–143736, 19 June 1996; LACM 144266–144292, 7 June 1997), and 3 were from Hakoné Mountain (35°12'N, 139°00'E), ca. 800 m elevation, Hakoné, Kanagawa Prefecture, Honshu Island, Japan (LACM 143714, 28 May 1980; LACM 143712, 13 May 1986; LACM 143713, 8 June 1993). The body cavity was opened by a longitudinal incision from vent to throat and the gastrointestinal tract was removed and opened longitudinally. Nematodes were removed, placed in undiluted glycerol, allowed to clear, and examined under a light microscope. Measurements are given in micrometers.

Results

Parapharyngodon japonicus sp. n.

(Figs. 1–6)

Description

GENERAL: Robust nematodes with prominent annulations beginning just behind cephalic extremity and continuing to anus. Moderate sexual dimorphism. Triangular oral opening surrounded by 3 bilobed lips. One small, pedunculate amphid on each ventrolateral lip. Lateral alae present in males, absent in females. Males without caudal alae; caudal filament directed dorsally. Females with conical tail terminating in short, stiff spike.

MALE (holotype and 9 paratypes; mean and

range): Length 789 (620–1,170). Width 131 (115–153). Lateral alae beginning near level of esophagus isthmus, increasing gradually in width and ending abruptly about 80 μ m anterior to cloaca. Annulations about 2 μ m apart. Esophagus 160 (131–177), bulb length 45 (40–51), bulb width 43 (37–48). Nerve ring 116 (86–143), excretory pore 57 (40–74) from anterior, respectively. Tail 27 (23–34), reduced to a slim appendage inserted dorsally and directed obliquely to longitudinal axis of body. Spicule 53 (45–57). Testis reflexed behind esophagus. Three pairs of caudal papillae: 1 pair ventral, precloacal; 1 pair sublateral, postcloacal; 1 pair on caudal appendage. Posterior cloacal lip thickened centrally.

FEMALE (allotype and 9 paratypes; mean and range): Length 2,493 (1,820–3,250). Without lateral alae. Width at vulva 469 (306–714). Esophagus 298 (257–336), bulb length 85 (68–100), bulb width 92 (72–114). Nerve ring 206 (125–239), excretory pore 718 (459–969), vulva 1,207 (765–1,785) from anterior, respectively. Tail 91 (57–114). Amphidelphic; uteri divergent; anterior uterus directed anteriorly, posterior uterus directed posteriorly; ovaries reflexed, remaining below level of esophageal bulb; muscular ovijector, nonsalient vulva. Egg oval, in profile slightly flattened on 1 side, 92 (77–100) by 42 (34–48), thin-shelled, with subterminal operculum. Eggs in ovijector at pronucleus stage of development.

Taxonomic summary

TYPE HOST: *Onychodactylus japonicus* (Houttuyn, 1782).

TYPE LOCALITY: Hineomata, Fukushima Prefecture, Honshu Island, Japan, 37°01'N, 139°23'E.

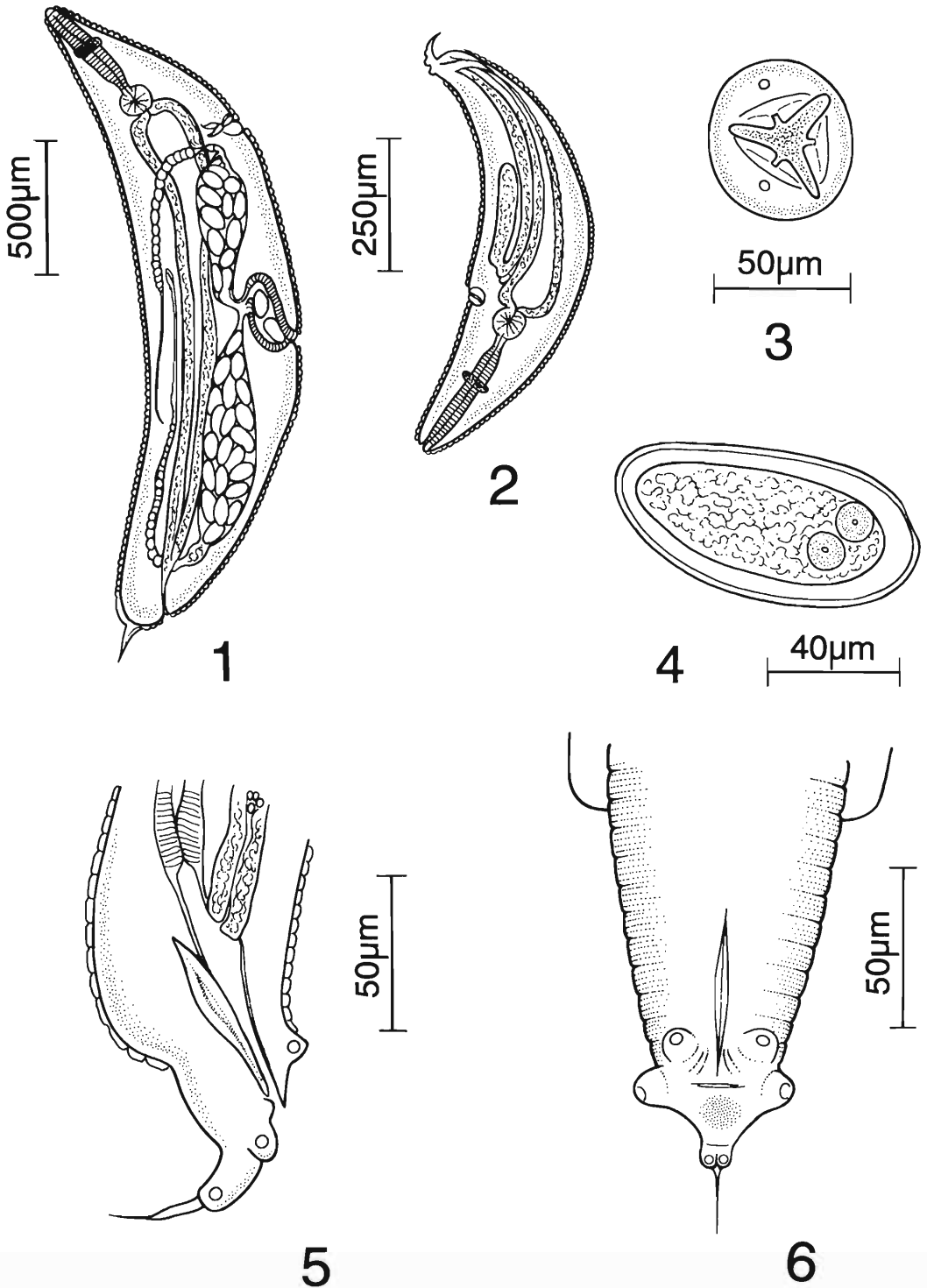
SITE OF INFECTION: Small intestine.

TYPE SPECIMENS: Holotype: male, U.S. National Parasite Collection, Beltsville, Maryland, USNPC 88238; allotype, female, USNPC 88239; paratypes (9 males, 9 females), USNPC 88240.

ETYMOLOGY: The new species is named in reference to the country of origin.

Discussion

We consider the most significant character for separation of *Parapharyngodon* and *Thelandros* to be egg morphology. Based on egg morphology, as defined by Castaño-Fernandez et al.



Figures 1–6. *Parapharyngodon japonicus* sp. n. 1. Female, entire, lateral view. 2. Male, entire, lateral view. 3. Female, en face view. 4. Egg, pronuclear stage. 5. Male, posterior end, lateral view. 6. Male, posterior end, ventral view.

Table 1. Current list and selected characters of species assigned to *Parapharyngodon*.

Biogeographical realm	Spicule (µm)	Cloacal lip	Ovary	Egg size (µm)	Reference
<i>Species of Parapharyngodon</i>					
Australian Realm					
<i>P. anomalus</i> Hobbs, 1996	63	echinate	prebulbar	83-95 × 43-50	Hobbs, 1996
<i>P. fitzroyi</i> Jones, 1992	80-92	echinate	prebulbar	88-96 × 48-56	Jones, 1992
<i>P. karrana</i> (Johnston and Mawson, 1941)	55	smooth	not given	75-90 × 35-45	Johnston and Mawson, 1941
Ethiopian Realm					
<i>P. adramitana</i> Adamson and Nasher, 1984	80-86	echinate	prebulbar	109-119 × 69-78	Adamson and Nasher, 1984
<i>P. bulbosus</i> (Linstow, 1899)	51-63	smooth	postbulbar	90-99 × 54-57	Moravec et al., 1987
<i>P. meridionalis</i> (Chabaud and Brygoo, 1962)	80	echinate	postbulbar	115 × 62	Chabaud and Brygoo, 1962
<i>P. rotundatus</i> (Malan, 1939)	96-140	smooth	prebulbar	84-108 × 52-56	Malan, 1939
<i>P. roussei</i> (Tcheprikoff, 1966)	110	echinate	prebulbar	not given	Tcheprikoff, 1966
Nearctic Realm					
<i>P. californiensis</i> (Read and Amrein, 1952)	53-76	smooth	prebulbar	90-110 × 48-52	Read and Amrein, 1952
<i>P. iguanae</i> (Telford, 1965)	43	echinate	prebulbar	85-98 × 43-53	Telford, 1965
Neotropical Realm					
<i>P. alvarengui</i> Freitas, 1957	80-100	smooth	prebulbar	78-87 × 39-52	Freitas, 1957
<i>P. cubensis</i> (Baus and Coy-Otero, 1969)	77	smooth	prebulbar	82-90 × 49-70	Baus and Coy-Otero, 1969
<i>P. garciae</i> Schmidt and Whittaker, 1975	30-45	smooth	prebulbar	80-85 × 50-56	Schmidt and Whittaker, 1975
<i>P. largior</i> Alho and Oliveira-Rodrigues, 1963	54-68	smooth	prebulbar	72-82 × 32-33	Alho and Oliveira-Rodrigues, 1963
<i>P. osteopli</i> Adamson, 1981	53-61	echinate	prebulbar	110-129 × 47-61	Adamson, 1981
<i>P. scleratus</i> (Travassos, 1923)	80-109	smooth	prebulbar	77-126 × 36-54	Baus, 1973
<i>P. verrucosus</i> Freitas and Dobbin, 1959	55-63	smooth	prebulbar	78-82 × 35-38	Freitas and Dobbin, 1959
Oriental Realm					
<i>P. almoniensis</i> (Karve, 1949)	85-105	echinate	postbulbar	80-100 × 50-70	Karve, 1949
<i>P. calotis</i> (Johnson, 1966)	31	smooth	prebulbar	91-92 × 38-54	Johnson, 1966
<i>P. kasauli</i> (Chatterji, 1935)	94-114	smooth	not stated	86-102 × 55-63	Chatterji, 1935
<i>P. muplestoni</i> Chatterji, 1933	76-90	smooth	prebulbar	80-91 × 42-50	Chatterji, 1933
Palearctic Realm					
<i>P. dogieli</i> Markov and Bogdanov, 1965	93-110	echinate	prebulbar	127-135 × 48-56	Sharpilo, 1976
<i>P. echinatus</i> (Rudolphi, 1819)	74-112	echinate	postbulbar	88 × 45	Seurat, 1917
<i>P. lilfordi</i> Castaño-Fernandez, Zapatero-Ramos, So- lera-Puertas, and Gonzalez-Santiago, 1987	67-85	smooth	prebulbar	99 × 66	Castaño-Fernandez et al., 1987
<i>P. japonicus</i> sp. n.	45-57	smooth	postbulbar	77-100 × 34-48	this study
<i>P. micipsae</i> (Seurat, 1917)	88	echinate	prebulbar	91 × 50	Seurat, 1917
<i>P. pavlovskiyi</i> Markov, Atsev, and Bogdanov, 1968	74-87	echinate	prebulbar	91-100 × 48-56	Sharpilo, 1976
<i>P. psammotromi</i> Roca and Lluich, 1986	absent	smooth	prebulbar	88-104 × 52-62	Roca and Lluich, 1986
<i>P. skryabini</i> Vakker, 1969	139-176	smooth	postbulbar	82-93 × 46-48	Sharpilo, 1976
<i>P. nyche</i> Sulahian and Schacher, 1968	100-110	smooth	postbulbar	90-100 × 45-60	Sulahian and Schacher, 1968

(1987), the species harbored by *Onychodactylus japonicus* is assigned to the genus *Parapharyngodon*.

The most recent list of species of *Parapharyngodon* is that of Baker (1987), in which 33 species are listed. *Parapharyngodon aegyptiacus* Moravec, Barus, and Rysavy, 1987, has since been transferred to *Skrjabinodon* Inglis, 1968, by Moravec and Barus (1990). Six species on Baker's list have eggs with terminal opercula; thus, based on the criteria of Castaño-Fernandez et al. (1987), these species should be assigned to *Thelandros*, namely, *T. awokoyai* (Babero and Okpala, 1962) comb. n.; *T. bicaudatus* Read and Amrein, 1952; *T. maculatus* Caballero, 1968; *T. pseudothaparius* Lucker, 1951; *T. senisfaciecaudus* (Freitas, 1957) comb. n.; and *T. xantusi* Lucker, 1951. The egg morphology has not been described for 4 species from Baker's list, *P. bulbosus* (Linstow, 1899) Freitas, 1957; *P. garciae* Schmidt and Whittaker, 1975; *P. kartana* (Johnston and Mawson, 1941) Adamson, 1981; and *P. mabouia* (Rao and Hiregauder, 1962) Adamson, 1981. We were able to examine a specimen of *P. kartana* (USNPC 88241), the eggs of which had subterminal opercula. Specimens of *P. bulbosus*, *P. garciae*, and *P. mabouia* were not available for examination. Until egg morphology is described, we will provisionally retain *P. bulbosus* and *P. garciae*; *P. mabouia* is inadequately described and is to be considered a species inquirendae. Five additional, recently described species should be added to Baker's list, namely *P. psammodromi* Roca and Lluch, 1986; *P. lilfordi*, Castaño-Fernandez, Zapatero-Ramos, Solera-Puertas, and Gonzalez-Santiago, 1987; *P. fitzroyi* Jones, 1992; *P. anomalus* Hobbs, 1996; and *P. japonicus* sp. n. A revised list of *Parapharyngodon* is given in Table 1.

In addition to the species in Table 1, 10 species assigned to *Parapharyngodon* are considered species inquirendae: females are unknown for *P. szczerbaki* Radchenko and Sharpilo, 1975; males are unknown for *P. cincta* (Linstow, 1897) Freitas, 1957, *P. megaloon* (Linstow, 1906) Adamson, 1981, and *P. waltoni* (Read and Amrein, 1952) Adamson, 1981; inadequately described are *P. aspiculus*, Khera, 1961, *P. cameroni* (Belle, 1957) Adamson, 1981, *P. evaginatus* Fotedar, 1974, *P. fotedari* Kalyankar and Palladwar, 1977, *P. macrocerca* Fotedar, 1974, and *P. seurati* (Sandground, 1936) Freitas, 1957.

Species of *Parapharyngodon* are distin-

guished on the basis of the morphology of the anterior cloacal lip, the location of the ovary, and geographical distribution (Table 1). Of the 30 species in Table 1, with the exception of *P. anomalus*, *P. garciae*, and *P. japonicus*, all are parasites of lizards. Of the 9 species reported from the Palaearctic Realm, *Parapharyngodon japonicus* is most similar to *P. tyche* in that the anterior cloacal lip is smooth, the ovary is post-bulbar, and the eggs are thin-walled and oval in outline. These 2 species differ in that the spicule of *P. japonicus* is half the length of that in *P. tyche*, and the lateral alae of *P. japonicus* end abruptly about 80 μ m anterior to the cloaca, whereas in *P. tyche*, the lateral alae continue to the end of the body.

Hasegawa (1988) reported an unidentified species of *Parapharyngodon* from the lizard *Ateuchosaurus pellopleurus* Hallowell, 1860 from Okinawa, Japan. This species differs from *P. japonicus* in that its ovarian coils are prebulbar, the tail of the female is conical, and the egg has a pitted, thick wall and is somewhat triangular in outline.

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Report on the Brayton H. Ransom Memorial Trust Fund

The Brayton H. Ransom Memorial Trust Fund was established in 1936 to “encourage and promote the study and advancement of the Science of Parasitology and related sciences.” Income from the Trust currently provides token support of the *Journal of the Helminthological Society of Washington* and limited support for publication of exceptionally meritorious manuscripts by authors lacking institutional or other backing. Donations or memorial contributions may be directed to the Secretary-Treasurer. Information about the Trust may be found in the following articles in the *Proceedings of the Helminthological Society of Washington* (1936) 3:84–87; (1983) 50:200–204 and (1993) 60:144–150.

Financial Report for 1998

Balance on hand, January 1, 1998	\$22,203.00
Receipts:	\$1,586.69
Contributions from Members of the Helminthological Society of Washington	
1996	\$247.00
1997	\$195.00
Interest received in 1998	\$1,144.69
Disbursements	(\$500.00)
Support of author's page charges	(\$200.00)
Grant to the Helminthological Society of Washington for 1998	(\$50.00)
Membership in the American Association for Zoological Nomenclature ..	(\$50.00)
Expenses of WAAVP Workshop (1997)	(\$200.00)
On hand, December 31, 1998	\$23,289.69

J. Ralph Lichtenfels
Secretary-Treasurer
USDA:ARS:BARC-East, No. 1180
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